PATENT ABSTRACTS OF JAPAN

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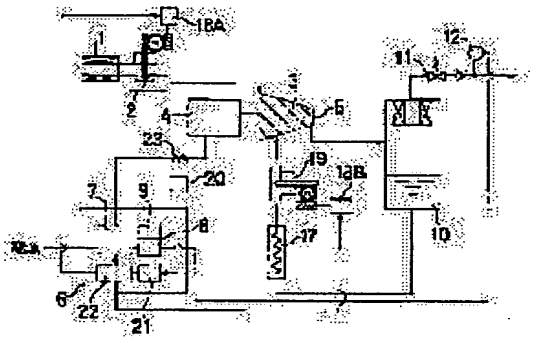
(54) INVERTER DRIVEN SCREW COMPRESSOR

(57)Abstract:
PURPOSE: To adjust the amount of intake air and the amount of oil automatically during low revolution and control the number of revolutions to 0% ratio of the amount of the used air in a screw compressor for controlling the number of revolutions.
CONSTITUTION: A suction throttle valve 2 driven by a pulse motor 18A to control number of revolutions to no load condition and an oiling throttle valve 1 driven by a pulse motor 18B in an oiling system are provided in an inverter driven screw compressor having a motor 4, an inverter 7 and a compressor body 3, etc. A PID device 21 for comparing and calculating detected current of the motor 4 with its set current and a control device 22 for receiving a frequency signal from the inverter 7 and controlling the pulse motor according to the signal from the PID device 21 are also mounted in the compressor. Thus, inverter driving to 0% ratio of amount of air used (no load) can be carried out as capacity control of the screw compressor, so that a large energy saving effect can be obtained. A piping can be simplified by applying an electric system to control of a suction throttle valve so that manufacturing manhours can be reduced.



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CLAIMS

(57) [Claim(s)]
[Claim 1] With the body of a screw compressor which rotates by the motor, air is inhaled and compressed from an inhalation network. Supply the compressed air to a load side through an oil separator, and oil is supplied to said body of a screw compressor through oil feeding system from this oil separator. In the inverter drive screw compressor which was made to carry out adjustable control of the engine speed of said motor by the inverter driving means, while preparing an adjustable oil supply throttle valve in said oil feeding system It is based on the frequency data from said inverter, the current data supplied to said motor, and the current data set up beforehand. A valve-control means to control said adjustable oil supply throttle valve to press down the current value of said motor which will increase if said motor becomes low rotation is established. The inverter drive screw compressor characterized by making it control in the direction which extracts said adjustable oil supply throttle valve according to the fall of rotation of said body of a screw compressor with said valve-control means at the time of low rotation operation of said body of a screw compressor.
[Claim 2] It is the inverter drive screw compressor characterized by having the control device which controls the drive current of said motor based on the measurement result measured with a current monitor means for said valve-control means to supervise the drive current of said motor in an inverter drive screw compressor according to claim 1, and to measure the drive current at the time of low rotation of this motor, and this current monitor means.
[Claim 3] It is the inverter drive screw compressor which prepares an adjustable intake throttle valve in said inhalation network of a compressor, and it is made to drive said both throttle valves through transfer devices, such as a worm-gear pinion rack, in an inverter drive screw compressor according to claim 1 or 2 by the pulse motor, respectively in addition to said adjustable oil supply throttle valve, and is characterized by said valve-control means presupposing that it is controllable like [the adjustable intake throttle valve of said induction system] the adjustable oil supply throttle valve of said oil feeding system.

[Translation done.]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the inverter drive screw compressor which could be made to carry out an inverter drive in all the load range from constant-pressure control and a full load to no-load in the inverter drive screw compressor which performs a displacement control by revolving speed control.
[0002]
[Description of the Prior Art] Conventionally, as an example of the technique about the inverter drive of a screw compressor, although JP,55-164792,A is raised, the well-known example which controls an intake air

content and the amount of oil supply to coincidence, and was made to carry out an inverter drive in all the range of a load at the time of low rotation is not found. Moreover, in 0 - 30% of range of a low load, although it was used in 30 - 100% of range of a load in the conventional inverter drive screw compressor, having carried out adjustable control of the rotational frequency, since rotation was set constant and it was considering as the intake throttle valve control by the pressure regulating valve, energy saving by revolving speed control was not obtained, but there was a fault from which a discharge pressure also changes.

[0003] Drawing 4 and drawing 5 explain the revolving speed control of the conventional method in an inverter drive screw compressor. The body 3 of a screw compressor is driven by the motor 4 and direct connection, and, as for a motor 4, an operation control is performed by the starting board 6.

[0004] The air inhaled from the inlet filter 1 is compressed in the body 3 of a compressor with the lubricating oil supplied from the oil separator 10 via the absorption throttle valve 2. A lubricating oil and the compressed air separate oil by the oil separator 10, it is cooled by the cooler 17 and an oil is again supplied to the body 3 of a compressor. The air compressed by the body 3 of a compressor is compressed to the pressure set up by the regurgitation port 5. The air which passed the oil separator 10 is supplied to a load side through a regulator valve 11 and an after cooler 13.

[0005] The PID equipment 8 which carries out the comparison operation of the data of the pressure sensor 12 and the pressure setter 9 which detect the supply pressure other than an inverter 7 is formed in the starting board 6. From PID equipment 8, change control of the rotational frequency of a motor 4 is carried out so that a frequency may be changed with delivery and an inverter 7 and it may become supply-pressure regularity about the data which set a pressure constant at an inverter 7. a use air content ratio (a use air content / specification air content) as shows an example of the range of revolving speed control to drawing 5 -- 30 - 100% of range -- carrying out -- a use air content ratio -- by 30 - 0% of low load, a rotational frequency is set constant and intake throttle valve control is performing. if a use air content ratio becomes 30% or less -- a rotational frequency -- although a valve will open a pressure gradually if it rises and turns into a setting pressure of a pressure regulating valve 14 since it becomes the control set constant -- this -- the value of immobilization of 30% -- not but, it fluctuates suitably.

[0006] The air which went via the pressure regulating valve 14 is supplied to the lower part of the piston 16 of the intake throttle valve 2 through pneumatic piping P1, pushes up a piston 16, blockades the intake throttle valve 2 on a stepless story, and carries out capacity adjustment. Moreover, in order to open the pressure of an oil separator 10 wide to atmospheric air at the time of a halt and to close the intake throttle valve 2, generally the air vent valve 15 is formed, the pressure of an oil separator is released by atmospheric air through pneumatic piping P1, but since the concrete configuration is well-known, illustration is omitted.

[0007]

[Problem(s) to be Solved by the Invention] With the inverter drive screw compressor of the conventional method, as described above, in order to prevent the overcurrent trip by the lack of torque of the motor in low rotation, when it became the frequency which is equivalent to 30% of load to a full load, revolving speed control was stopped and it had changed to the intake throttle valve control by the pressure regulating valve as fixed rotation. Although control of the load range of 0 - 30% of use air quantitative ratios was covered by this method As shown by the straight line of an inverter drive in drawing 5 by such method, Rhine of 30% or less of load It is located 30 to 100% more nearly up than the virtual production of Rhine of a load, That is, in order to acquire the energy-saving effectiveness which a power loss produces at the time of a low load, and to control by the pressure regulating valve and to obtain a setting pressure, adjustment was required each time, and it became a supply pressure buildup, and there was a trouble that it could not consider as a constant pressure.

[0008] the troubles with the above purpose of this invention -- solving -- the time of a low load -- setting -- a frequency or the rotational frequency of a compressor -- corresponding -- an intake air content and the amount of oil supply -- regulating automatically -- carrying out -- the overcurrent trip at the time of low rotation -- preventing -- a constant pressure -- and a use air content ratio -- the load of 0 - 100% of range performs revolving speed control, and it is in offering the inverter drive screw compressor with which supply of the stable air in low rotation and the big energy-saving effectiveness are acquired.

[0009]

[Means for Solving the Problem] In order to attain the above-mentioned purpose, the inverter drive screw compressor by invention concerning claim 1 With the body of a screw compressor which rotates by the motor, air is inhaled and compressed from an inhalation network. Supply the compressed air from a load side through an oil separator, and oil is supplied to said body of a screw compressor through oil feeding

system from this oil separator, the inverter drive screw compressor which was made to carry out adjustable control of the engine speed of said motor by the inverter driving means, while preparing an adjustable oil supply throttle valve in said oil feeding system It is based on the frequency data from said inverter, the current data supplied to said motor, and the current data set up beforehand. A valve-control means to control said adjustable oil supply throttle valve to press down the current value of said motor which will increase if said motor becomes low rotation is established. It is characterized by making it control in the direction which extracts said adjustable oil supply throttle valve according to the fall of rotation of said body of a screw compressor with said valve-control means at the time of low rotation operation of said body of a screw compressor. In the inverter drive screw compressor by invention which similarly relates to claim 1 as for the inverter drive screw compressor by invention concerning claim 2, said valve-control means is characterized by to have a current monitor means supervises the drive current of said motor and measure the drive current at the time of low rotation of this motor, and the control unit which control the drive current of said motor based on the measurement result which measured with this current monitor means. The inverter drive screw compressor by invention concerning claim 3 still the more nearly same In addition to said adjustable oil supply throttle valve, in the inverter drive screw compressor by invention concerning claims 1 or 2, an adjustable intake throttle valve is prepared in said inhalation network of a compressor. Said both throttle valves It is made to drive through transfer devices, such as a worm-gear pinion rack, by the pulse motor, respectively. Said valve-control means It is what is characterized by making controllable the adjustable intake throttle valve of said induction system as well as the adjustable oil supply throttle valve of said oil feeding system. A pulse motor is operated so that the current value of the motor which will increase if this becomes low rotation may be pressed down, and control which is stepless and blockades each throttle valve is performed.

[0010]

[Function] The above-mentioned means acts as follows. Drive connection is carried out and a motor and the body of a compressor perform revolving speed control with an inverter. For example, a pressure sensor is attached in regurgitation piping and a supply pressure is inputted into transfer and the frequency command from an inverter by the inverter via PID equipment with an electrical signal at a valve-control means. Moreover, the data of the detection current from a current transformer etc. prepared in the power line of a motor are inputted into a valve-control means. If a valve-control means gets to know the present frequency and a current value and becomes below the set-up frequency, it compares a programmed-current value with said detection current value. It blockades gradually and goes until a detection current, i.e., a drive current, will fall said adjustable oil supply throttle valve, if this current value increases. thereby -- the lack of torque in low rotation -- improvable -- a use air content ratio -- an inverter drive is attained in 0 - 100% of range. Moreover, a fixed pressure is always obtained in the above-mentioned range, and the energy-saving effectiveness in low rotation also increases.

[0011]

[Example] Drawing 1 and drawing 2 explain one example of this invention below. In drawing 1 , the same sign is given to the same member as drawing 4 , and the explanation is omitted. Suppose that an inverter drive is possible for the range of 100 - 0% of use air quantitative ratios, i.e., no-load, from a full load in this invention. The current of a motor 4 always supervises with a current transformer 23, a current is changed into that data by the electrical potential difference by the current repeater 20, and it is sent to PID equipment 21, and the comparison operation of it carries out to this data by which electrical-potential-difference conversion was carried out, and the data set up beforehand, and it has the composition of making the pulse motor control unit 22 rotating delivery and pulse motors 18A and 18B, with this PID equipment 21 in data with which a current serves as the minimum by the system of an inverter drive shown in drawing 1 . Pulse motors 18A and 18B drive the intake throttle valve 2 and the oil supply throttle valve 19 suitably through [rack / a worm and a worm gearing, / pinion] a means of communication. The workload of a screw compressor has three persons of the effect of the back pressure from the oil separator 10 which joins the regurgitation port 5 of the body 3 of a compressor other than compression of the intake air from an inlet filter 1, and the viscosity of the oil supplied to the body 3 of a compressor via an oil cooler 17, and the torque of a fixed limit is always needed. In order to also lower an electrical potential difference although a frequency is lowered to reducing rotation when driving with an inverter 7, in the low rotation region equivalent to a low load, it becomes impossible for a motor 4 to draw out the above-mentioned torque, a current increases, and an overload trip occurs.

[0012] This invention loses such an overload trip, if it starts low rotation operation, will detect the increment

in a current with a current transformer 23, and will change it into an electrical potential difference by the converter 20. To PID equipment 21 Delivery, The amount which compresses intake air while the pulse motor control device 22 supervises the frequency from an inverter 7 further based on the data sent from PID equipment 21 It blockades until rotate pulse motor 18A and it controls the intake throttle valve 2, and rotates pulse motor 18B of oil supply, it controls the oil supply throttle valve 19 and a current falls. That is, a motorised current is controlled so that a motor rotational frequency may become the minimum current according to a frequency in a low rotation region. This intake throttle valve 2 and the oil supply throttle valve 19 are made into the structure which all transmits the rotation from pulse motors 18A and 18B to the shaft which turned off the screw by the worm gearing and the transfer gear, is made to go up and down this shaft, and can carry out adjustable [of the opening of a valve].

[0013] By this example, the workload of a compressor 3 can be mitigated by the configuration described above in a low rotation region, it carries out regulating automatically of the balance of a frequency, the amount of intake, and the amount of oil supply, the torque of a motor is backed up, an overcurrent trip is prevented, and the energy-saving effectiveness is demonstrated. Drawing 2 and 3 are a graph showing the property of the displacement control by this invention, and its control approach. Here, a use air content ratio blockades and controls the intake throttle valve 2 and the oil supply throttle valve 19 by 30% or less of load with the fall of a frequency. A load is judged on a frequency, the peak current is judged by current data, each valve is detected by the command from a control device, the data after adjustment and adjustment are again detected with a frequency and a current, and feedback control is carried out. It is possible to reduce the power loss at the time of a low load like the conventional example mostly mentioned above about drawing 5 as a linear by this although the load characteristic shifted rather than ideal Rhine, and to do the energy-saving effectiveness so. Moreover, since the displacement control of a screw compressor is performed electrically, the piping P1 grade shown in required drawing 4 R> 4 when controlling by the air type conventionally is omissible.

[0014]

[Effect of the Invention] according to this invention -- the displacement control of a screw compressor -- a use air content ratio -- since an inverter drive can be carried out to 0%, while being able to supply a fixed pressure to 0 - 100% of load, responsibility of a load effect can also be carried out early Moreover, since a motor current is restricted at the time of a low load, the large energy-saving effectiveness in a low load region can be done so. Moreover, since electric system constitutes a displacement control also from a manufacture side, and piping is lost, improvement in productivity and a standardization can be achieved.

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] Drawing showing one example of the inverter drive screw compression equipment by this invention

[Drawing 2] Drawing showing the capacity control characteristic of the inverter drive screw compression equipment shown in drawing 1

[Drawing 3] Drawing showing the displacement-control approach of the inverter drive screw compression equipment shown in drawing 1

[Drawing 4] Drawing showing the system of the inverter drive screw compression equipment of the conventional method

[Drawing 5] Drawing showing the capacity control characteristic of the inverter drive screw compression

equipment of the conventional method

[Description of Notations]

2 -- Intake throttle valve 4 -- Motor

7 -- Inverter 8 -- PID equipment

12 -- Pressure sensor 18 -- Pulse motor

19 -- Oil supply throttle valve 20 -- Current repeater

21 -- PID equipment for currents 22 -- Pulse motor control unit

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[Translation done.]